# SCOTTSDALE FIRE APPARATUS REPLACEMENT

Executive Development

Develop an apparatus replacement plan for the Scottsdale Fire Department

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## Certification Statement

I herby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that the appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

## Abstract

The problem is that Scottsdale Fire does not have experience with an apparatus replacement program. Research was conducted to answer questions regarding vehicle standards and practices used by other industries and fire departments. The research revealed that the criteria used by most industries and fire departments are based on age. There are other critical factors that can be tracked to determine replacement such as out of service time, mileage, work order history, cost per mile and technology changes. The recommendation for the Scottsdale Fire Department is to use a 10 year cycle for Engines and 12 years for Ladders as a budget guideline. The entire fleet will be evaluated annually using performance factors to determine a more accurate replacement schedule.

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## Introduction

The problem is that the newly formed City of Scottsdale Fire Department does not have experience with managing a fire apparatus replacement program. Fire department apparatus in the City of Scottsdale were previously procured and maintained by the Rural Metro Corporation as part of their contract with the City. Safe and reliable apparatus is a key component to firefighter safety. The purpose of this research is to determine a standard method of calculating the service life and other critical elements of an apparatus replacement program that could be used by the Scottsdale Fire Department in developing a long range apparatus replacement plan. The approach used in this research project will be the descriptive research method. The approach will be to research applicable laws and standards that impact fire apparatus lifespan. Research how other government entities and private industries calculate service life for trucks similar to fire apparatus. Send a questionnaire to similar sized Fire Departments in the United States and local Fire Departments to determine what methodology is used to calculate the service life of apparatus and what performance measures are used to track reliability of apparatus. This data will be used to determine a standard service life for the apparatus used by Scottsdale and to develop a long range replacement plan. The research questions used to gather the necessary data for this project:

1. What laws and standards have an impact on service life and other critical elements of managing fire apparatus?
2. How other industries that operate similar sized vehicles calculate service life and collect data about the vehicles they use?
3. How are other fire departments calculating service life and collecting data about the apparatus that they use?

## Background and Significance

The City of Scottsdale is a medium sized suburban community on the east side of the Phoenix Metro area. The City has a population of 232,929 in a 184.2 square mile area (City of Scottsdale, 2007). The Scottsdale Fire Department (SFD) operates out of 13 fire stations with 13 Engines and 3 Ladder trucks. A 14th fire station is currently under construction in the downtown section of the city. SFD has a reserve fleet of 4 Engines and 1 Ladder truck. The front line apparatus currently used by SFD were purchased between 1999 and 2006. The Fire Department also operates several specialty units including brush trucks, water tenders, a hazardous materials response vehicle, a technical rescue response vehicle and airport rescue firefighting vehicles. The Department has 250 employees to provide service to the citizens of Scottsdale. The Fire Department provides advanced life support emergency medical service (EMS), fire suppression, technical rescue, airport rescue firefighting (ARFF) and hazardous materials responses. EMS transports are provided by a private ambulance company (Professional Medical Transport Company) through a contract with the City. The Scottsdale Fire Department responds on an average of 23,000 calls for service per year. SFD operates as part of the Phoenix-Metro automatic aid consortium. All of the fire departments in the Phoenix area automatically respond to incidents regardless of city borders. The 24 cities that participate in the consortium are all dispatched by the Phoenix Fire Department and operate using the same set of operating procedures.

In the 1950's when Scottsdale was a small rural community Lou Witzeman, a local businessman purchased a fire truck and sold subscriptions for his service to the residents (About Rural Metro, 2006). This private fire department grew to become the Rural Metro Corporation. The focus of the Rural Metro Corporation shifted over the years to providing ambulance service.

The City of Scottsdale maintained a contract with Rural Metro to provide fire and EMS service to the residents until 2005. In 2003 Rural Metro notified the City of Scottsdale that they would be terminating the contract with the City and ending a nearly 50 year relationship. The only viable option for Scottsdale was to begin providing municipal fire and EMS service. In July of 2005 the contract with Rural Metro was officially terminated. The City began a transition to a municipal fire department in 2004 with the hiring of Chief William McDonald. The City of Scottsdale owned the fire apparatus and fire stations that had been operated by Rural Metro.

The City of Scottsdale began operating a municipal fire department on July 1, 2005. Prior to the transition to a municipal fire department all of the fire apparatus were purchased by the City of Scottsdale using specifications and recommendations from Rural Metro. The vehicles were maintained by Rural Metro and the City relied on guidance from Rural Metro on replacement timelines.

City of Scottsdale Fleet Management does not have experience with maintaining a fleet of fire apparatus. The Fleet division did maintain a fleet of heavy vehicles including road working equipment and refuse trucks. The issues faced by the City and the Fire Department relate to the section on Organizational, Culture and Change presented in the Executive Development course at the National Fire Academy. Taking over a fleet of fire apparatus was a significant change for the Fleet department.

The fleet of fire apparatus that was taken over by the City has already experienced significant maintenance issues and down time. The average operational out of service time for our fleet of Engines and Ladder trucks is 20% see Appendix A. The operational out of service time for our fleet of reserve apparatus is 23%. The vehicles used by Scottsdale Fire are also experiencing high mileage due to high call volume and a large geographic coverage area. The

condition and operational availability of fire apparatus is a key component to firefighter safety and the ability to provide service to the residents of Scottsdale. This is a growing issue and responding to it relates to the USFA operational objective; to respond appropriately in a timely manner to emerging issues.

The Scottsdale Fire Department needs to determine a methodology for determining a life cycle for fire apparatus so a long term replacement plan can be created. A replacement plan will assist the Fire Department with long range budgeting for the future.

## Literature Review

A literature review was completed to research applicable information pertaining to the questions for this research project. The first question: What laws and standards have an impact on service life and other critical elements of managing fire apparatus? Applicable laws pertaining to operation of heavy trucks was researched. United States DOT (Department of Transportation) rules do not specifically give guidelines on service life of vehicles. To meet DOT standards vehicles need to be maintained and have the appropriate safety equipment installed. (United States, 2006). A search of local laws pertaining to equipment lifespan revealed similar findings. Vehicles in the State of Arizona are required to comply with inspection laws and have proper repairs and adjustments made (Arizona Revised, 2007). There are no specific references to the life span of a vehicle. If a vehicle can be maintained and pass local inspections the vehicle can remain in service indefinitely. Vehicles also need to have the appropriate safety equipment installed.

The applicable standards used by the fire service relating to fire apparatus are the National Fire Protection Association (NFPA) 1901. According to the NFPA 1901 standard:

> Apparatus built prior to 1991 might have few of the safety upgrades required by the 1991 and subsequent editions of the NFPA fire department apparatus standards of the equivalent Underwriters' Laboratories of Canada (ULC) standards. Because the changes, upgrades, and fine tuning to the NFPA 1901 since 1991 have been truly significant, especially in the area of safety, fire departments should seriously consider the value (or risk) to firefighters by keeping pre-1991 fire apparatus in first-line service… It is a generally accepted fact that fire apparatus, like all types of mechanical devices, have a finite life. How long that is depends on many factors. Some of those factors are mileage, quality of preventative maintenance program, quality of the driver training program and rules enforcement, quality of the original builder and components, availability of parts, and custom or commercial chassis to name a few. In the fire service, there are fire apparatus with 8 to 10 years of service that are just plain worn out. (NFPA, 2003)

The NFPA standard brings out many of the key elements that need to be considered to determine the useful service life of fire department apparatus. The key element in assessing apparatus life span is firefighter safety; older apparatus do not meet the same safety standards that newer apparatus must meet. Newer fire apparatus have also incorporated many technology and safety changes.

Question number two states: How other industries that operate similar sized vehicles calculate service life and collect data about the vehicles they use? In researching commercial and industry standards one method for calculating a vehicle's lifespan is by factoring cost of maintenance, operations, downtime and obsolescence and when the costs have exceeded the replacement cost the vehicle has reached the end of it's life (Heavy Vehicle, 2005). The life cycle of a vehicle can be determined by a graph comparing the capital cost of a vehicle to the

operating cost of the vehicle. When the operating cost exceeds the capital cost the vehicle has reached the end of its useful life. When the operating cost equals the capital cost where the curves meet another consideration is to refurbish the vehicle. Refurbishing may be a cost effective alternative to replacement (Robertson, 2003).

In an article posted on the Association of Equipment Management Professionals web site one of the most useful tools in determining a vehicle's lifespan is through work orders. Work orders track a vehicles history including maintenance costs, scheduling, equipment repairs and other factors. (Ingalls, 2006). The maintenance history of a vehicle may determine that it is not cost effective to retain and replacement may be in order.

Some of the key elements in a fleet replacement plan are empirically validated replacement guidelines, having a plan that is updated annually and replacing vehicles based on earmarking and prioritization (Lauria, 2006).

An important element in developing a replacement program is benchmarking. Performance measures need to be defined and data collected on the defined benchmarks. The data needs to be evaluated for trends and to determine the best practice for the replacement program. Statistics gathered should be compared to other industries to determine appropriate standards. This will create a more cost effective program (Lauria, 2003).

Question number three states: How are other fire departments calculating service life and collecting data about the apparatus that they use? According to statistics provided by the Federal Emergency Management Association (FEMA) half of all fire engines in the United States are greater than 15 years old (FEMA, 2002). Safety and support are two of the key reasons to replace existing apparatus (Cavette, 2006). Improvements to suspension systems and anti-lock braking systems have improved the ride and safety of newer fire apparatus. Parts availability and service

are also key reasons to replace older apparatus. Parts manufacturers can go out of business making older apparatus more difficult to maintain. Older apparatus can become obsolete due to lack of available replacement parts (Cavette, 2006).

There are three different factors that determine life cycles of fire apparatus, service, technology and economic (Henry, 2007). If a vehicle is properly maintained the service life can be extended. The economic factors that influence the life span including depreciation, operating costs, maintenance repairs, downtime, obsolescence, inventory control and training (Henry, 2007).

The Fort Worth Fire Department in Fort Worth, Texas uses a guideline of 100,000 miles and 10 years of service for a front line apparatus (Vaccaro, 2007). The Fort Worth Fire Dept. also ensures that new apparatus meets the changing needs of the fire service. Their newer apparatus incorporate the latest safety features and Compressed Air Foam Systems (CAFS).

Fire Departments are finding that traditional time frames for apparatus replacement are not meeting the needs of the modern fire service. Increases in call volume and related mileage increases have caused departments to replace apparatus prior to the expected timeframe. Traditional replacement cycles of 15 to 20 years are being replaced with cycles of 8 to 12 years. Another consideration is to have apparatus rebuilt. This can be an economically viable alternative considering the increases in costs for newer fire apparatus (Shand, Wilbur, 2007).

The Fire Service in Manchester England did a study on apparatus replacement and determined that front line apparatus should last ten years, however there should be flexibility built in to a replacement program. They use a computer assisted management program to track costs and determine which apparatus should be targeted for replacement. They use this tool to develop an apparatus replacement program (Leckie, 1991).

The literature review showed that there are many factors that can be used to determine apparatus replacement cycles. A plan should be based on statistical data that is maintained for the fleet and benchmarked against other fire departments.

## Procedures

For this Applied Research Project a Literature Review was conducted to determine what laws and standards applied to apparatus lifespan and replacement. The Literature Review was conducted at the Learning Research Center (LRC) at the National Fire Academy (NFA). Searches were conduced using keywords on the (LRC) Online Card Catalog. Further research was conducted using search engines on the Internet. Keyword searches were made using Google and Yahoo searching for terms such as vehicle life span, vehicle standards, fire apparatus life span and fire apparatus maintenance and performance standards. Fire Department standards were researched using Scottsdale Fire Department's copy of the National Fire Protection Association (NFPA) National Fire Codes. Vehicle laws were researched in the Arizona Revised Statutes and using online searches of the United States Department of Transportation web site.

To determine how other industries calculate vehicle lifespan and replacement schedules a vehicle life span questionnaire was created (See Appendix B). The questionnaire was created using an online survey tool SurveyMonkey.com. The questionnaire was sent to the Rocky Mountain Fleet Management Association (RMFMA) through the Fleet Director for the City of Scottsdale. The (RMFMA) is made up of private and public fleet managers from Colorado, Arizona, New Mexico, Nevada and Utah. A link for the survey with an introduction message was posted on the (RMFMA) web site. This group was chosen to determine practices used by fleet managers operating vehicles in similar conditions in the same general geographic area. The data

obtained was for all types of heavy vehicles were used to give a perspective on vehicle replacement outside of the fire service.

To determine how other Fire Departments calculate vehicle lifespan and replacement schedules an apparatus replacement questionnaire was created that was similar to the one created for the (RMFMA). The apparatus replacement questionnaire had more Fire Department specific questions (See Appendix C). SurveyMonkey.com was used to create the apparatus replacement questionnaire and to gather the data. This questionnaire was sent out to three different groups to obtain as large of a sample group as possible. The questionnaire was designed to determine what criteria are used by other fire departments to determine vehicle replacement. The questionnaire also was used to determine how long other fire departments are currently retaining their apparatus, both engines and aerial apparatus.

The first group the apparatus replacement questionnaire was sent to was all of the Fire Departments in the Phoenix-Metropolitan automatic aid consortium. A personal email was sent to twenty of the local Fire Departments with an introductory letter and a link to the questionnaire. The email targeted the responsible person in each Fire Department for fleet management. The Phoenix-Metro Fire Departments were chosen since they operate in identical conditions and operationally are similar to the Scottsdale Fire Department. The departments in the Phoenix-Metro area operate in an automatic aid consortium and all use the same set of operating procedures. Fire Departments in the Phoenix area also operate in adverse weather conditions that consist of extreme heat and dust conditions which can lead to premature wear and tear on fire apparatus.

To obtain wider distribution the apparatus replacement questionnaire was sent to two additional groups. The questionnaire was posted on the International Association of Fire Chief's

(IAFC) web site with an introductory letter and a link to the survey. The introductory letter and link were posted in the Arizona announcements section. The questionnaire and introductory letter were also posted on The National Society of Executive Fire Officers web site. These two postings would give a larger sample group from across the United States. Many of the Fire Departments that data was obtained from operate under different circumstances, such as no EMS, small volunteer organizations or rural departments with decreased call volume compared to Scottsdale. The data is still useful to obtain since it may show alternative practices or procedures that are not used locally. Data from both of the questionnaires were downloaded into spreadsheets for data analysis. A summary of the results was compiled and included in Appendix D and Appendix E. The questionnaire also included the opportunity for the respondent to receive the results with the hope that this would encourage more participation.

## Results

The search for applicable laws and standards relating to apparatus lifespan and replacement did not yield significant results. There are no federal or state vehicular laws that limit the service life of a vehicle. Vehicles just need to be maintained to minimum standards and have appropriate safety equipment installed (United States, 2006) (Arizona Revised, 2007). NFPA 1901 does recommend replacing vehicles that were built prior to 1991 due to significant safety standard changes (NFPA, 2003).

A vehicle life span questionnaire was created to determine how industries outside of the fire service calculate service life of heavy vehicles. The questionnaire was posted on the RMFMA web site for a 30 day period. I received 24 responses to the questionnaire. The responses primarily were from State, County and Municipal government entities that operate

heavy vehicles. The entities that responded operate heavy vehicles such as dump trucks, graders, front end loaders, heavy utility trucks and solid waste trucks See Appendix D for a summary of the results.

The most significant finding is that 100% of the respondents use age as one of the criteria for replacing a vehicle. The other factors that are used to determine replacement are mileage, cost per mile, out of service time, obsolete parts, general condition, change in mission and technology changes. Several of the respondents in the other criteria listed evaluating cost of repairs. Excessive costs for repairs were considered greater than 20% of vehicle resale value. When the cost of repairs becomes too high the vehicle is targeted for replacement. Another factor that was listed was change in mission or requirements for the use of the vehicle. Several respondents also had a vehicle inspection program to determine if the vehicle had more useful service life or should be replaced or rebuilt.

An apparatus replacement questionnaire was used to determine how other fire departments calculate service life of vehicles and collect data. The apparatus replacement questionnaire was sent directly to all of the local fire departments in the Phoenix-Metro automatic aid consortium. Out of 20 departments locally in Phoenix, 15 responded to the questionnaire. The questionnaire was also posted on the IAFC web site and the National Society of Executive Fire Officers web site. A total of 81 responses were received over a 60 day period from across the United States. See Appendix E for a summary of the results. The majority of the responses came from smaller communities, 55.6% came from departments that served a population of less than 50,000. Only 14.8% of the responses came from communities similar in size to Scottsdale in the 100,000 to 250,000 population served.

The findings of the questionnaire were that the majority of the departments use age as the primary criteria for replacement with 92.6% reporting that they use age. The other factors used to determine replacement were mileage, cost per mile, out of service time, parts availability, funding and repair issues. The largest percentage for available service life was greater than 15 years, 37% for Engines and 36.3% for aerial apparatus which is similar to the findings found in FEMA's survey (FEMA, 2002).

The results showed that the primary factor used to determine heavy vehicle or fire apparatus lifespan is age. Mileage was the second most common factor used. Other factors that were listed in the questionnaire results were cost per mile, out of service time, parts availability, obsolete technology, general apparatus condition, ability to pass inspection, maintenance costs, pump hours, evaluation of major repairs, and changes in safety equipment, technology changes and general apparatus condition. Both questionnaires under the other category stated that there was an inspection program or annual inspection program to asses the vehicles to determine replacement status.

## Discussion

The fire service in the United States has a history of replacing fire apparatus based primarily on age. The findings of the questionnaires that were sent out showed that this is still the primary factor used today. The fire service has changed over the past 30 years with an increase in services provided. Most fire departments provide EMS and many other customer services that have increased call volume dramatically, especially in urban areas. This change translates to an increase in mileage and wear and tear on apparatus. This is the case in Scottsdale, where over 60% of the incidents that are EMS.

Fire apparatus design and safety features have also dramatically changed over the past 20 years. Older fire apparatus can be maintained and meet the legal requirements to stay roadworthy (United States, 2006) (Arizona Revised, 2007); however they should be considered for replacement to meet modern technology and safety standards. The NFPA standard also recommends replacing older apparatus to meet newer standards (NFPA, 2003). Apparatus manufacturers are including many new safety features such as anti-lock brakes, independent front suspension, anti-roll technology, airbags, electronic monitoring and controls. Older apparatus do not meet the same safety standards as newer models. This finding was also pointed out by several authors in the literature review (Cavette, 2006) (Vaccaro, 2007) (Henry, 2007).

The results of the questionnaire that was sent to the RMFMA showed a difference in the criteria used for heavy vehicle replacement outside of the fire service. Age was still the primary factor used to determine replacement cycles but mileage and cost per mile played a much more significant role in determining life span. The fire service can learn from operators outside of the fire service and develop performance criteria to determine replacement cycles that take into account factors other than age. The literature review that was completed showed many recommendations for using criteria other than age including newer safety features and new technology (Cavette, 2006) (Henry, 2007) (Ingalls, 2006) (Lauria, 2003).

The Scottsdale Fire Department has already experienced high operational out of service rate with the current fleet of apparatus. The majority of the fleet that is used by SFD is less than five years old. If age is the only criteria used to determine replacement SFD is likely to experience a high failure rate of apparatus in the future. A replacement program should be more flexible and use other criteria such as the program in Fort Worth Texas (Vaccaro, 2007).

## Recommendations

My recommendation to the City of Scottsdale Fleet director will be to use a guideline of 10 years of service life for Engines and 12 years for Ladders. This recommendation is primarily for long range budget purposes. I am going to recommend that each year all of our vehicles are assessed to determine which fire apparatus should be targeted for replacement. The age guideline should have significant flexibility built in to ensure that apparatus are replaced that do not meet the needs of the Fire Department.

The Scottsdale Fire Department and City of Scottsdale Fleet Division need to work together to track performance measures that can be used to determine the useful service life for our apparatus. Scottsdale Fleet is already tracking operational out of service time, work order history and cost per mile. The Scottsdale Fire Department also tracks mileage. Replacement should be based on a host of factors such as age, mileage, cost per mile, out of service percentage, work order history, general condition and changes in technology and safety. A matrix will be created to track all of the performance measures for each of the apparatus used by Scottsdale Fire. Apparatus may need to be replaced earlier than the target dates if performance measures indicate a vehicle has reached the end if it's useful service life. Some of the indicators would be mileage over 100,000 miles, cost per mile greater than other apparatus, excessive work orders and excessive out of service percentage as compared to other apparatus. Apparatus with excessive repair costs could also be targeted for early replacement. Performance indicators from other local cities would also be gathered to benchmark our performance against our neighbors.

The Scottsdale Fire Department and City of Scottsdale Fleet can also implement changes to ensure that we get the maximum service out of our vehicles. Scottsdale has a dense population in the south part of the city and sparse rural areas to the north. The call volumes that units in the

south part of the city are dramatically more than in the north portions of the city. Apparatus assigned to the south can be rotated to the north part of the city when they get higher mileage to decrease the cumulative wear. City of Scottsdale Fleet and the Fire Department will work together to ensure that a comprehensive preventative maintenance plan is in place to ensure our apparatus are kept in good condition. A schedule will be used to ensure that all fire apparatus have a quarterly preventative maintenance check along with an annual pump test.

The recommendations from this report will be incorporated into the next Scottsdale Fire Department Strategic plan and Operational Plan. The Strategic Plan is updated every two years and the Operational Plan is updated annually. This will ensure that the guidelines are reviewed for necessary changes each year.

References

*About Rural Metro Our History*. (2006). Retrieved June 7, 2007, from http://www.ruralmetro.com/about/ourhistory.htm

*Arizona Revised Statutes*. (2007). Retrieved May 25, 2007, from Arizona State Legislature Web site: http://www.azleg.gov

Cavette, C. (2006). Out with the Old. *Fire Chief, 50*(2), 62-66.

*City of Scottsdale Quick Statistics*. (2007). Retrieved June 7, 2007, from http://www.scottsdaleaz.gov/economics/_documents/2006QuickStats.pdf

FEMA. (2002). *A Needs Assessment of the U.S. Fire Service* (FA-240). Washington, DC: U.S. Government Printing Office.

*Heavy vehicle selection guide*. (2005). Retrieved May 23, 2007, from http://www.itsa.govt.nz/commercial/hvy-veh-selection/index.html

Henry, D. (2007). Managing the Fire Apparatus Life Cycle. *Iafc on Scene, 21*(2), 5.

Ingalls, P. (2006). *Life Cycle Analysis: Work Orders Document a Fleet's History*. Retrieved May 24, 2007, from http://www.aemp.org

Lauria, P. (2003). Benchmarking in an Era of Heightened Accountability & Budget Constraints. *Government Fleet*, 16-21.

Lauria, P. (2006). Trends in Fleet Management [Electronic version]. In *NCSFA Conference* (p. 10). Savannah, GA: Mercury.

Leckie, L. (1991). Fleet review means better vehicle replacement system. *Fire, 84*, 11-12.

National Fire Academy. (2003). *Executive Fire Officer Program, Operational Policies and Procedures, Applied Research Guidelines*. Emmitsburg, MD

NFPA. (2003). *NFPA 1901 Standard for Automotive Fire Apparatus*. Avon, MA: National Fire Protection Association.

*Publication Manual of the American Psychological Association* (5th ed.). (2001). Washington, DC: American Psychological Association.

Robertson, D. (2003). Replace vs. Refurbish Fire Apparatus. *Government Fleet*, 14-16.

Shand T., Wilbur, M, (2007). The Apparatus Architect. *Firehouse, 32*(7), 108-111.

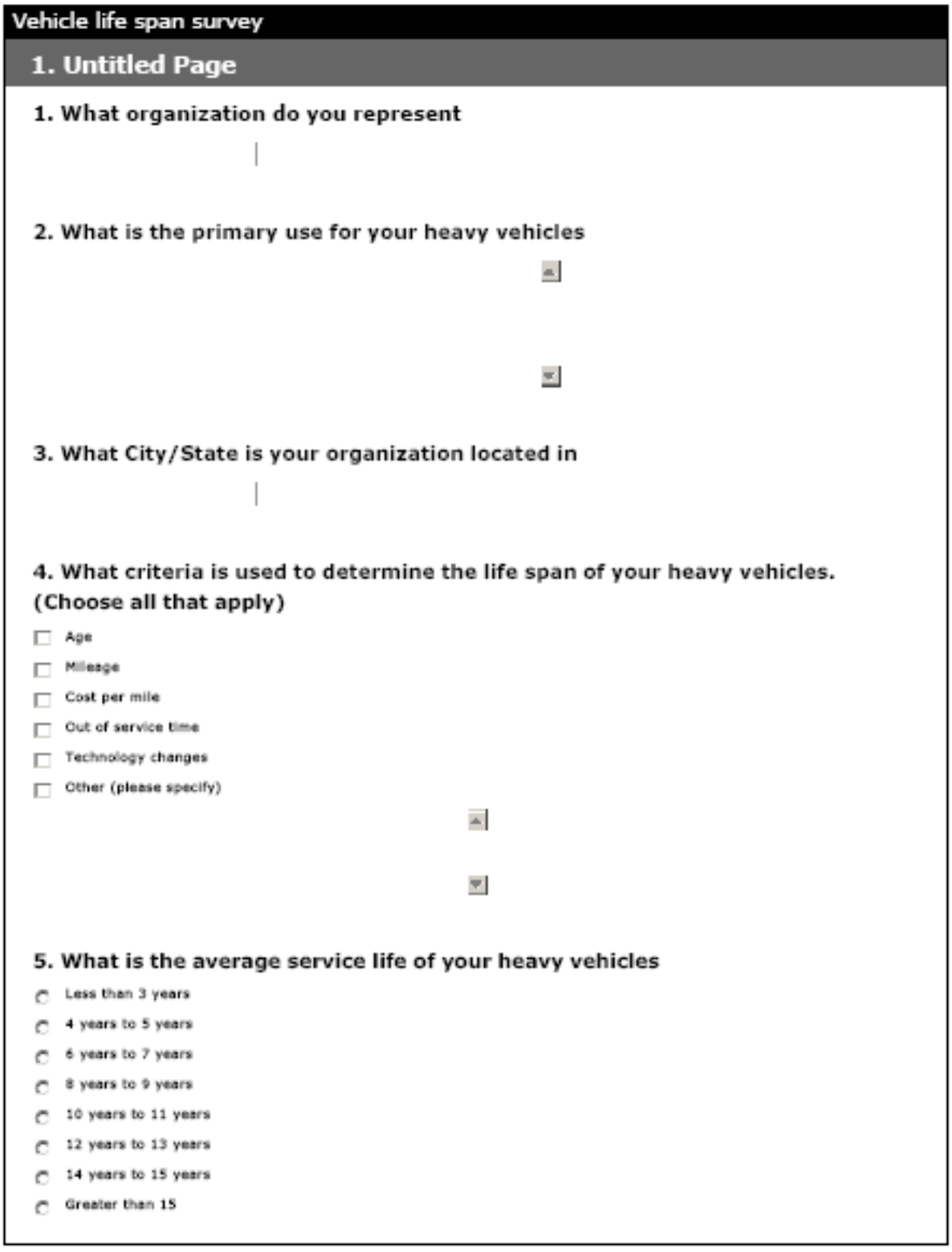
United States Department of Transportation. (2006). *Federal Motor Vehicle Safety Standards 49CFR571*. Available from Code of Federal Regulations, http://frwebgate2.access.gpo.gov

Vaccaro, B. (2007). Where the West Begins. *Fire Rescue, 25*(2), 30-32.

Appendix A

| Scottsdale Fire Operational Downtime 2006 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unit Number | Designation | Year | Make | Model | Type | Maintenance Downtime | Operational Downtime | % |
| 0006867 | Reserve | 1994 | International | 4800 | Pumper | 166 | 174 | 2% |
| 0006871 | Reserve | 1996 | Pierce | Sabre | Pumper | 1542 | 1318 | 15% |
| 0006877 | E613 | 1999 | American LaFrance | Eagle | Pumper | 2188 | 2914 | 33% |
| 0006879 | E614 | 2001 | Freightliner | FL80 | Pumper | 1222 | 1632 | 19% |
| 0006880 | E606 | 2002 | American LaFrance | Eagle | Pumper | 925 | 1174 | 13% |
| 0006883 | E616 | 2002 | American LaFrance | Eagle | Pumper | 1382 | 1794 | 20% |
| 0006884 | L611 | 2002 | American LaFrance | Eagle | Ladder | 2195 | 2874 | 33% |
| 0006887 | E601 | 2004 | American LaFrance | Eagle | Pumper | 1829 | 2409 | 28% |
| 0802881 | E607 | 2002 | American LaFrance | Eagle | Pumper | 1527 | 2038 | 23% |
| 0802882 | E6022 | 2002 | American LaFrance | Eagle | Pumper | 1744 | 2338 | 27% |
| 0802885 | S606 | 2002 | Freightliner | FL80 | SORT | 202 | 284 | 3% |
| 0803889 | BR614 | 2003 | Ford | F550 | Brush Truck | 986 | 1304 | 15% |
| 0803890 | BR607 | 2003 | Ford | F550 | Brush Truck | 583 | 769 | 9% |
| 0804862 | L603 | 2004 | American LaFrance | Eagle | Platform | 1458 | 1933 | 22% |
| 0804886 | E609 | 2004 | American LaFrance | Eagle | Pumper | 3514 | 4689 | 54% |
| 0804888 | E603 | 2004 | American LaFrance | Eagle | Pumper | 2465 | 3260 | 37% |
| 0804891 | T615 | 2004 | Freightliner | FL80 | Tanker | 524 | 653 | 7% |
| 0804892 | T610 | 2004 | Freightliner | FL80 | Tanker | 0 | 0 | 0% |
| 0804893 | E605 | 2004 | American LaFrance | Eagle | Pumper | 1768 | 2364 | 27% |
| 0804894 | E610 | 2004 | American LaFrance | Eagle | Pumper | 1307 | 1746 | 20% |
| 0804895 | F609 | 2004 | Oshkosh | Striker | ARFF | 2390 | 3216 | 37% |
| 0806896 | E602 | 2006 | American LaFrance | Eagle | Pumper | 1050 | 1386 | 16% |
| 0806897 | E615 | 2006 | American LaFrance | Eagle | Pumper | 1214 | 1655 | 19% |
| 0806927 | L604 | 2006 | American LaFrance | Eagle | Ladder | 1705 | 2316 | 26% |
| 0885870 | F6092 | 1985 | E-One | Titan | ARFF | 1925 | 2596 | 30% |
| 0890864 | Reserve | 1990 | Federal | Hush | Pumper | 2822 | 2188 | 25% |
| 0890865 | Reserve | 1990 | KME | Spartan | Pumper | 1278 | 1660 | 19% |
| 0894876 | BR616 | 1994 | Chevrolet | C31 | Brush Truck | 927 | 943 | 11% |
| 0896872 | HM605 | 1996 | International | 1652 | Haz-Mat Van | 1014 | 1366 | 16% |
| 0897192 | BR611 | 1997 | Chevrolet | C20 | Service Body | 350 | 139 | 2% |
| 0897873 | U606 | 1997 | International | 4900 | Utility Truck | 1261 | 1682 | 19% |
| 0897928 | BR611 | 1997 | Chevrolet | C30 | Brush Truck | 719 | 963 | 11% |
| 0898875 | Reserve | 1998 | E-One | Hurricane | Ladder | 1653 | 1835 | 21% |
| 0899878 | Reserve | 1999 | Freightliner | Metro | Pumper | 2352 | 3143 | 36% |
| | | | | | | | | |
| | | | | | Totals: | 48187 | 60755 | |
| | | | | | | | | |
| | | | | | Average: | 1417 | 1787 | 20% |
| | | | | | Reserve average: | | | 23% |

Appendix B



Vehicle life span survey

1. Untitled Page

1. What organization do you represent

2. What is the primary use for your heavy vehicles

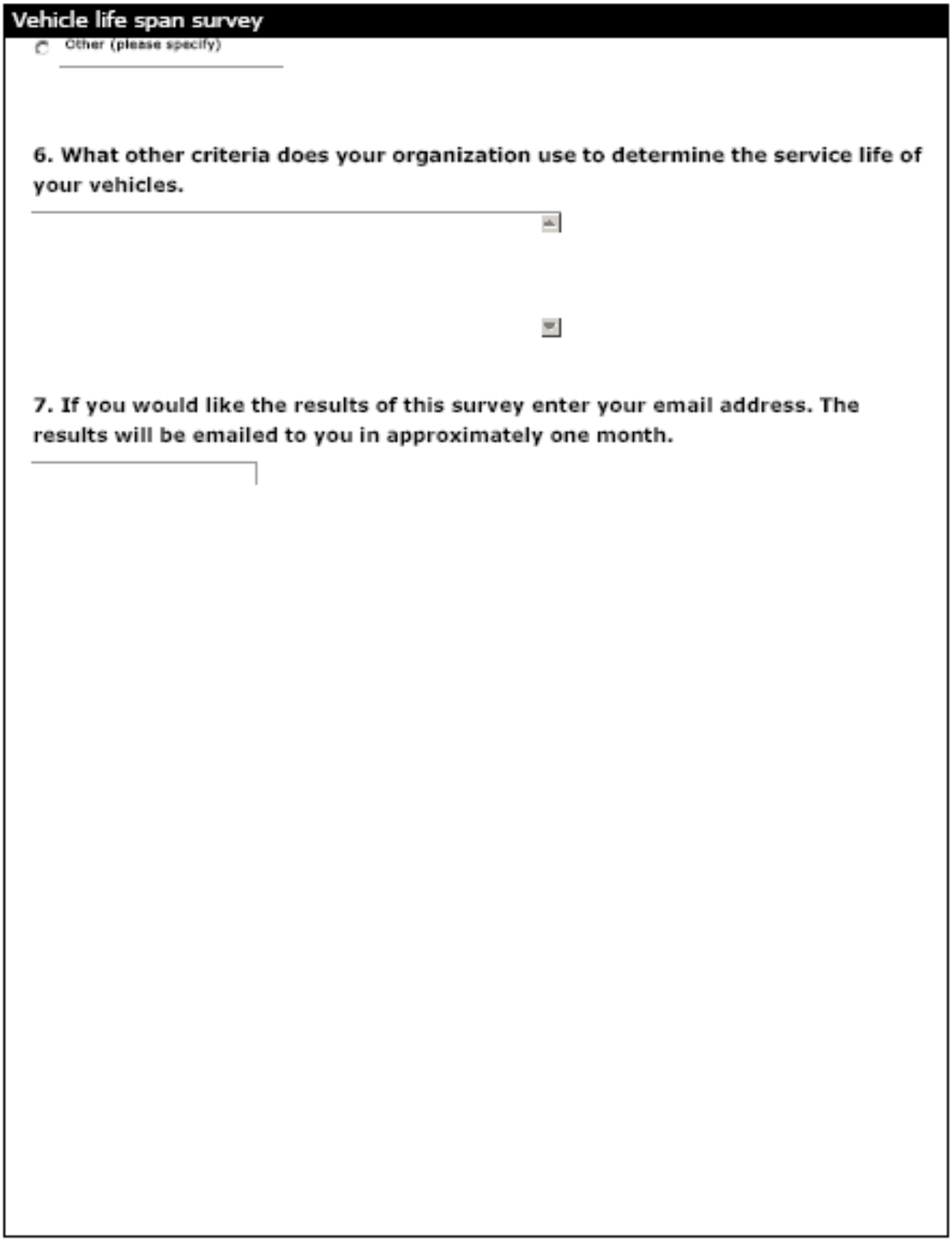
3. What City/State is your organization located in

4. What criteria is used to determine the life span of your heavy vehicles. (Choose all that apply)

- [ ] Age
- [ ] Mileage
- [ ] Cost per mile
- [ ] Out of service time
- [ ] Technology changes
- [ ] Other (please specify)

5. What is the average service life of your heavy vehicles

- ( ) Less than 3 years
- ( ) 4 years to 5 years
- ( ) 6 years to 7 years
- ( ) 8 years to 9 years
- ( ) 10 years to 11 years
- ( ) 12 years to 13 years
- ( ) 14 years to 15 years
- ( ) Greater than 15


Vehicle life span survey

Other (please specify)

6. What other criteria does your organization use to determine the service life of your vehicles.

7. If you would like the results of this survey enter your email address. The results will be emailed to you in approximately one month.

Appendix C

Apparatus replacement survey

1. Untitled Page

1. What is the name of your Department

2. What City/State is your department located in

3. What is the size of the community served by your Fire Department

- ◯ Less than 50,000
- ◯ 50,000 to 100,000
- ◯ 100,000 to 250,000
- ◯ Greater than 250,000

4. What criteria does your department use to determine the service life of apparatus. (Choose all that apply)

- ☐ Age
- ☐ Mileage
- ☐ Cost per mile
- ☐ Out of service time
- ☐ Other (please specify)

5. What is the average service life of your Engines

- ◯ Less than 8 years
- ◯ 8 to 10 years
- ◯ 11 to 12 years
- ◯ 13-14 years
- ◯ 15 years
- ◯ Greater than 15
- ◯ Other (please specify)

**Apparatus replacement survey**

**6. What is the average service life for your Aerial apparatus?**

- ○ Less than 8 years
- ○ 8 to 10 years
- ○ 11 to 12 years
- ○ 13-14 years
- ○ 15 years
- ○ Greater than 15
- ○ Other (please specify)

**7. What other criteria does your Department use to determine the service life of your apparatus.**

**8. If you would like the results of this survey enter your email address. The results will be emailed to you in approximately one month.**

# Appendix D

## Heavy Vehicle Survey Summary

What criteria are used to determine the life span of your heavy vehicles? (Choose all that apply)

| answer options | Response Percent | Response Count |
|---|---|---|
| Age | 100.00% | 24 |
| Mileage | 87.50% | 21 |
| Cost per mile | 66.70% | 16 |
| Out of service time | 45.80% | 11 |
| Technology changes | 29.20% | 7 |
| Other (please specify) | 8.30% | 2 |
| | answered question | 24 |
| | skipped question | 0 |

What is the average service life of your heavy vehicles

| answer options | Response Percent | Response Count |
|---|---|---|
| Less than 3 years | 0.00% | 0 |
| 4 years to 5 years | 0.00% | 0 |
| 6 years to 7 years | 8.30% | 2 |
| 8 years to 9 years | 16.70% | 4 |
| 10 years to 11 years | 25.00% | 6 |
| 12 years to 13 years | 12.50% | 3 |
| 14 years to 15 years | 20.80% | 5 |
| Greater than 15 | 8.30% | 2 |
| Other (please specify) | 8.30% | 2 |

# Appendix E

## Apparatus Replacement Survey Summary

What is the size of the community served by your Fire Department

| answer options | Response Percent | Response Count |
|---|---|---|
| Less than 50,000 | 55.00% | 44 |
| 50,000 to 100,000 | 26.30% | 21 |
| 100,000 to 250,000 | 15.00% | 12 |
| Greater than 250,000 | 3.80% | 3 |

What criteria does your department use to determine the service life of apparatus. (Choose all that apply)

| answer options | Response Percent | Response Count |
|---|---|---|
| Age | 93.80% | 75 |
| Mileage | 41.30% | 33 |
| Cost per mile | 13.80% | 11 |
| Out of service time | 38.80% | 31 |
| Other (please specify) | 22.50% | 18 |

What is the average service life of your Engines

| answer options | Response Percent | Response Count |
|---|---|---|
| Less than 8 years | 3.80% | 3 |
| 8 to 10 years | 15.00% | 12 |
| 11 to 12 years | 12.50% | 10 |
| 13-14 years | 5.00% | 4 |
| 15 years | 17.50% | 14 |
| Greater than 15 | 36.30% | 29 |
| Other (please specify) | 10.00% | 8 |

What is the average service life for your Aerial apparatus?

| answer options | Response Percent | Response Count |
|---|---|---|
| Less than 8 years | 1.30% | 1 |
| 8 to 10 years | 1.30% | 1 |
| 11 to 12 years | 6.30% | 5 |
| 13-14 years | 3.80% | 3 |
| 15 years | 21.50% | 17 |
| Greater than 15 | 36.70% | 29 |
| Other (please specify) | 29.10% | 23 |